PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

Investigation Report for
BCA Bemidji

Minnesota
BCA
Bureau of Criminal Apprehension

7/25/2012

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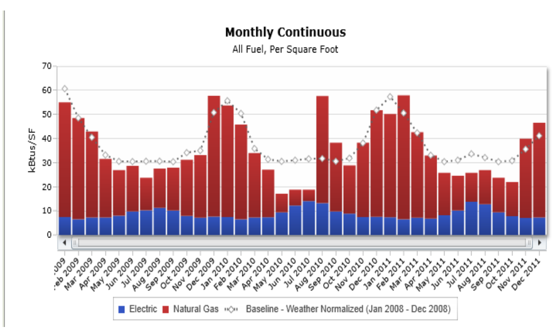
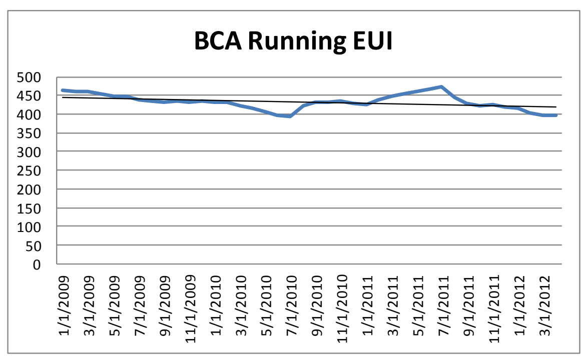
Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. A limited investigation of BCA Bemidji was performed by AMEC Earth and Environmental, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total Project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$36,358		Total Project Cost	$57,543
Future costs including Implementation , Measurement & Verification	$21,095		Study and Administrative Cost Paid with ARRA Funds	($39,358)
Total Project Cost	$57,543		Utility Rebates	($0)
			Total costs after co-funding	$18,095
Estimated Annual Total Savings ($)	$9,151		Estimated Annual Total Savings ($)	$9,151
Total Project Payback	6.3		Total Project Payback with co-funding	2.0
Electric Energy Savings	**9.3 %**	**and**	**Gas Energy Savings**	**6.6 %**





Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	26,854	11,671,076	12,229,293	-558,217	-5%	$114,993.23	$0.01
2010	365	26,854	11,542,499	12,096,624	-554,125	-5%	$119,978.91	$0.01
2011	365	26,854	11,247,809	12,045,697	-797,888	-7%	$133,110.10	$0.01

The energy use at BCA Bemidji decreased approximately 6% over the period of the investigation.

Admin Minnesota DEPARTMENT OF ADMINISTRATION

STATE OF MINNESOTA B3 BENCHMARKING

Summary Tables

Facility Name	BCA Bemidji
Location	3700 N Norris Court, Bemidji, MN 56601
Facility Managers	Jim Dougherty Assistant Laboratory Director
Interior Square Footage Investigated	26,854
PBEEEP Provider	AMEC Earth and Environmental, Inc.
Sate's Project Manager	Glen Heino
Study Period	December 2011 through April 2012
Annual Energy Cost	$133,110 (2011)
Utility Company	Electric: Ottertail Power Natural Gas: Minnesota Energy Resources
Site Energy Use Index (EUI)	433 kBtu/ft^2 (end of screening) 398 kBtu/ft^2 (end of study
Benchmark EUI (from B3)	301 kBtu/ft^2

The Bureau of Criminal Apprehension Laboratory is a single building that was constructed in 2001. Located in Bemidji, it includes laboratories, offices, parking garage and service areas.

Mechanical Equipment Included in Investigation: Summary Table	
Total	**Equipment Description**
1	Building Automation System (Schneider Electric IA/ JCI)
1	Buildings
26,854	Interior Square Feet
1	Air Handler
50	VAV Boxes
37	EVAV Boxes
2	Exhaust Fans
2	Chillers (1 working)
4	Boilers (2 Hot Water, 2 Steam)
6	Pumps (HW, CHW, etc)

Implementation Information			
Estimated Annual Total Savings ($)	6.6% Savings		$9,151
Total Estimated Implementation Cost ($)			$18,095
GHG Avoided in U.S Tons (CO2e)			96
Electric Energy Savings (kWh) (2011 Usage 818,225 kWh)	9.3 % Savings		76,272
Gas Energy Savings (Therms) (2011 Usage was 84,560 Therms)	6.6 % Savings		5,589
Statistics			
Number of Measures identified			3
Number of Measures with payback < 3 years			1
Screening Start Date	11/10/2011	Screening End Date	11/18/2011
Investigation Start Date	12/19/2011	Investigation End Date	4/9/2012
Final Report	7/3/2012	Final Meeting	7/26/2012

BCA Bemidji Cost Information			
Phase		**To date**	**Estimated Future Cost**
Screening		$3,695	
Investigation [Provider]		$23,565	
Investigation [CEE]		$9,098	$1,000
Implementation			$18,095
Implementation [CEE]			$1,000
Measurement & Verification			$1,000
Total		$36,358	$21,095

Co-funding Summary	
Study and Administrative Cost	$39,358
Utility Co-Funding - Estimated Total ($)	$0
Total Co-funding ($)	$39,358

BCA Bemidji Overview

The energy investigation identified 7.3 % of total energy savings at BCA Bemidji with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at BCA Bemidji include decreasing ventilation in spaces when they are not in use, setting the office temperatures when they are unoccupied and properly setting the temperatures in a number of spaces. The total cost of implementing all the measures is $18,095.

Implementing all these measures can save the facility approximately $9,151 a year. During the period of the PBEEEP investigation energy use at BCA Bemidji decreased approximately 6% compared to the year prior to the study. It is now 32% above the benchmark value according to the Minnesota Benchmarking and Beyond database.

Controls and Trending

The mechanical equipment is controlled by a Schneider Electric-IA which was recently installed (2010) by UHL Company and controls all the mechanical equipment in the building. It is fully capable of trending and has the capacity to trend all the needed points for a PBEEEP energy investigation. Remote access can be granted to the system.

Temperature is controlled by individual thermostats in each room.

The systems operate 365 days a year, heat is always on and cooling is available whenever the outside temperature is above 50 degrees. The control points are set in the EMS and are the same all year.

Lighting

All interior lights are T8 32 watt lights. There are no occupancy sensors for any interior lights and all are controlled by light switches. There are seven lighting zones in the building. Most offices and labs have 2 switches and on average there are 6 to 8 lights per switch.

Exterior lights have a timer and a photocell. The lights operate off the photocell and turn on when it becomes dark outside.

Energy Use Index and B3 Benchmark

The site Energy Use Index (EUI) is 419 kBtu/sqft. This is 39% higher than the B3 Benchmark of 301 kBtu/sqft. The median site EUI for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks.

Metering

The building has one electric and one natural gas meter.

Findings Summary

Building: College Laboratory
Site: BCA Bemidji

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
2	Over ventilating the lab areas.	$11,513	$7,814	1.47	$0	1.47	80
3	Zone setpoint is sub optimal.	$459	$97	4.72	$0	4.72	1
1	Office area does not setback temperature at night.	$6,123	$1,240	4.94	$0	4.94	15
	Total for Findings with Payback 3 years or less:	**$11,513**	**$7,814**	**1.47**	**$0**	**1.47**	**80**
	Total for all Findings:	**$18,095**	**$9,151**	**1.98**	**$0**	**1.98**	**96**

PBEEEP was made possible with funding from the U.S. Department of Energy
and the MN Department of Commerce.

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Rev. 2.0 (12/16/2010)

17000 - BCA Bemidji Regional Office

This checklist is designed to be a resource and reference for Providers and PBEEEP.

Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
a. Equipment Scheduling and Enabling:	a.1 (1)	Time of Day enabling is excessive	Yes	Entire facility		This issue is being evaluated.
	a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	Yes	Entire facility		This issue is being evaluated.
	a.3 (3)	Lighting is on more hours than necessary.	None		Investigation looked for, but did not find this issue.	
	a.4 (4)	OTHER_Equipment Scheduling/Enabling			Investigation looked for, but did not find this issue.	
b. Economizer/Outside Air Loads:	b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position, economizer setpoints not optimized)			Not Relevant	Relief is not availble to the office wing and the lab requires 100% OA.
	b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set to design specifications or occupancy.			Not Relevant	
	b.3 (7)	OTHER_Economizer/OA Loads			Investigation looked for, but did not find this issue.	
c. Controls Problems:	c.1 (8)	Simultaneous Heating and Cooling is present and excessive			Not Relevant	Lab requires humidity control.
	c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement			Not cost-effective to investigate	
	c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints			Investigation looked for, but did not find this issue.	
	c.4 (11)	OTHER_Controls			Investigation looked for, but did not find this issue.	
d. Controls (Setpoint Changes):	d.1 (12)	Daylighting controls or occupancy sensors need optimization.			Investigation looked for, but did not find this issue.	
	d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	x	Office Area.		The main office area does not setback the temperature at night. Lab areas have specialized equipment and test that run and need constant temperatures at all times.
	d.3 (14)	Fan Speed Doesn't Vary Sufficiently	yes			Issue is being addressed.
	d.4 (15)	Pump Speed Doesn't Vary Sufficiently			Investigation looked for, but did not find this issue.	
	d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary	x	Lab Area.		Lab area exhaust VAV boxes are constant at all times. The only exhaust VAV boxes that need to be constant are the ones for the fume hoods.
	d.6 (17)	Other_Controls (Setpoint Changes)			Investigation looked for, but did not find this issue.	
e. Controls (Reset Schedules):	e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal			Not cost-effective to investigate	
	e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal			Investigation looked for, but did not find this issue.	
	e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			Not Relevant	
	e.6 (22)	Other_Controls (Reset Schedules)			Investigation looked for, but did not find this issue.	
f. Equipment Efficiency Improvements / Load Reduction:	f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit			Investigation looked for, but did not find this issue.	
	f.2 (24)	Pump Discharge Throttled	yes	Most pumps		
	f.3 (25)	Over-Pumping			Not cost-effective to investigate	
	f.4 (26)	Equipment is oversized for load.			Not cost-effective to investigate	
	f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			Investigation looked for, but did not find this issue.	
	g.1 (28)	VFD Retrofit - Fans			Investigation looked for, but did not find this issue.	

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Finding Category	Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding	Notes
g. Variable Frequency Drives (VFD):	**g.2 (29)**	VFD Retrofit - Pumps			Investigation looked for, but did not find this issue.	
	g.3 (30)	VFD Retrofit - Motors (process)			Not Relevant	
	g.4 (31)	OTHER_VFD			Investigation looked for, but did not find this issue.	
h. Retrofits:	**h.1 (32)**	Retrofit - Motors			Investigation looked for, but did not find this issue.	
	h.2 (33)	Retrofit - Chillers			Investigation looked for, but did not find this issue.	
	h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)			Not cost-effective to investigate	
	h.4 (35)	Retrofit - Boilers				
	h.5 (36)	Retrofit - Packaged Gas fired heating			Not Relevant	
	h.6 (37)	Retrofit - Heat Pumps			Not cost-effective to investigate	
	h.7 (38)	Retrofit - Equipment (custom)			Investigation looked for, but did not find this issue.	
	h.8 (39)	Retrofit - Pumping distribution method			Not cost-effective to investigate	
	h.9 (40)	Retrofit - Energy/Heat Recovery			Investigation looked for, but did not find this issue.	
	h.10 (41)	Retrofit - System (custom)			Investigation looked for, but did not find this issue.	
	h.11 (42)	Retrofit - Efficient Lighting			Investigation looked for, but did not find this issue.	
	h.12 (43)	Retrofit - Building Envelope			Not cost-effective to investigate	
	h.13 (44)	Retrofit - Alternative Energy			Not cost-effective to investigate	
	h.14 (45)	OTHER_Retrofit			Investigation looked for, but did not find this issue.	
i. Maintenance Related Problems:	**i.1 (46)**	Differed Maintenance from Recommended/Standard			Investigation looked for, but did not find this issue.	
	i.2 (47)	Impurity/Contamination			Investigation looked for, but did not find this issue.	
	i.3 ( )	Leaky/Stuck Damper			Investigation looked for, but did not find this issue.	
	i.4 ( )	Leaky/Stuck Valve			Investigation looked for, but did not find this issue.	
	i.5 (48)	OTHER_Maintenance			Investigation looked for, but did not find this issue.	
j. OTHER	**j.1 (49)**	OTHER			Investigation looked for, but did not find this issue.	

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**
	• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**
	• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**
	• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**
	• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**
	• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**
	• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**
	• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**
	• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**
	• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**
	• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**
	• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**
	• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**
	• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**	
		• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**	
		• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**	
		• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**	
		• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**	
		• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**	
		• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**	
		• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**	
		• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**	
		• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**	
		• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**	
		• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**	
		• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**	
		• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**	
		• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**	
		• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**	
		• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**
	• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**
	• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**
	• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**
	• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**
	• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**
	• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**
	• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**
	• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**
	• Please contact PBEEEP Project Engineer for approval

Findings Details

Building: College Laboratory

FWB Number:	17000	Eco Number:	1
Site:	BCA Bemidji	Date/Time Created:	7/3/2012

Investigation Finding:	Office area does not setback temperature at night.	Date Identified:	3/21/2012
Description of Finding:	The main office area does not setback the temperature during the night hours.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls contractor.	Benefits:	Energy savings.
Baseline Documentation Method:	Trends of the zone temperature setpoints and current temperature vs. time.		
Measure:	Implement an office unoccupied mode that shuts down office VAV air flow and implements a temperature setback for 6PM-6AM M-F and weekend operation.		
Recommendation for Implementation:	Create an office unoccupied mode for VAV-1, 2, 3, 4, 5, 6, 7, 8, 9, 10, and 11. The unoccupied mode schedule is 6pm-6am M-F and all of Saturday/Sunday. During unoccupied mode, set back the temperature in the office area by 10F. (~60 degrees Heating, ~80 degrees Cooling). Close VAVs 1-11 completely, but allow system to control to unoccupied temperature first and increase CFM as needed for each respective office VAV. Confirm accuracy of Office supply air and return air BAS points. The VAV boxes serving the lab shall remain unchanged by this measure.		
Evidence of Implementation Method:	15 minute trend data including OAT, AHU1 SF Speed, AHU1 Office SF CFM Flow, AHU1 DAT, AHU1 HR Air Temp (post coil), AHU1 RA CFM Flow. For each Office VAV (VAV 1-11): CFM, CFM setpoint, min flow, max flow, damper %, zone heating setpoint, zone cooling setpoint, current zone temperature, heating % output. Compare and confirm actual VAV flow against BAS AHU supply and return flow.		

Annual Electric Savings (kWh):	17,963	Contractor Cost ($):	$5,566
Estimated Annual kWh Savings ($):	$1,240	PBEEEP Provider Cost for Implementation Assistance ($):	$557
		Total Estimated Implementation Cost ($):	$6,123

Estimated Annual Total Savings ($):	$1,240	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	4.94	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	4.94	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	15	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	13.5%	Percent of Implementation Costs:	33.8%

Findings Details

Building: College Laboratory

FWB Number:	17000	Eco Number:	2
Site:	BCA Bemidji	Date/Time Created:	7/3/2012

Investigation Finding:	Over ventilating the lab areas.	Date Identified:	3/21/2012
Description of Finding:	All of the supply and exhaust VAV boxes run at constant volume all night long in the lab areas. These VAV boxes can be setback to maintain constant temperature and humidity, but reduce overall ventilation.		
Equipment or System(s):	VAV terminal unit	Finding Category:	Controls (Setpoint Changes)
Finding Type:	VAV Box Minimum Flow Setpoint is higher than necessary		

Implementer:	Controls contractor.	Benefits:	Energy savings.
Baseline Documentation Method:	Trends of the supply and exhaust VAV setpoint and current values vs. time.		
Measure:	Implement an unoccupied mode on all supply and exhaust VAV boxes in the lab area except fume hood dedicated E VAVs.		
Recommendation for Implementation:	Implement an unoccupied mode on all supply and exhaust VAV boxes in the open lab areas during the night hours of Monday - Friday 6:00PM - 6:00AM as well as all 48 hours on the weekend. Sheet 'Lab VAV' within the supplemental calculation workbook includes proposed VAV flow setpoint targets for the unoccupied mode. Ensure the exhaust VAV boxes for the fume hoods do not shut off.		
Evidence of Implementation Method:	Trend all available points for LAB VAVs 20-43 (15 min resolution). Trend all available points for LAB E-VAVs 7-35 (15 min resolution). Include a minimum of two weeks of data for a cooling, shoulder, and heating season. Johnson Controls DWG RS1.1 and RS1.2 clarify the requested VAV box tags. Collect 15 minute trend data including OAT, AHU-1 SF Speed, AHU-1 EF Speed, AHU-1 DAT, AHU-1 HR Air Temp (post HR coil), AHU1_HtgCl_T, AHU1_ExT (pre heat recovery), AHU1_ExT (post heat recovery), AHU1-RARH, AHU1_ClgVlv, AHU1_HtgVlv, AHU1_HR_Vlv, AHU1_Hmdf_Vlv, AHU1_Ex_SP, AHU1_Lab_Static_2, AHU1_Office_Static_1, AHU1_SpacePress, B1_St, B2_St, B3_St, B4_St.		

Annual Electric Savings (kWh):	58,309	Annual Natural Gas Savings (therms):	5,449
Estimated Annual kWh Savings ($):	$4,025	Estimated Annual Natural Gas Savings ($):	$3,790
Contractor Cost ($):	$10,467		
PBEEEP Provider Cost for Implementation Assistance ($):	$1,047		
Total Estimated Implementation Cost ($):	$11,513		

Estimated Annual Total Savings ($):	$7,814	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.47	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.47	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	80	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	85.4%	Percent of Implementation Costs:	63.6%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

PBEEEP State Government

Building: College Laboratory

FWB Number:	17000	Eco Number:	3
Site:	BCA Bemidji	Date/Time Created:	7/3/2012

Investigation Finding:	Zone setpoint is sub optimal.	Date Identified:	3/21/2012
Description of Finding:	Room 122, 172, 160 with respective VAV box 4, 28, 38 are set above the recommended value of 70F.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Zone setpoint setup/setback are not implemented or are sub-optimal		

Implementer:	Controls contractor.	Benefits:	Energy savings.
Baseline Documentation Method:	No trends available for these VAV boxes. Screenshots were provided to show space setpt, space temp, min cfm, max cfm, and current cfm values.		
Measure:	Reprogram the zone temperatures to 70F.		
Recommendation for Implementation:	Reprogram room 122, 172, 160 with respective VAV box 4, 28, 38 to the recommended value of 70F. Confirm box heating and cooling setpoints are acceptable to allow the target zone and room temperature setpoint.		
Evidence of Implementation Method:	Provide screenshots and trend 2 weeks of 15 minute data including VAV-4, 28, 38 zone setpoint, zone heating setpoint, zone cooling setpoint, zone temperature, room temperature, relative humidity, box CFM flow, box CFM flow sp,		

Annual Natural Gas Savings (therms):	140	Contractor Cost ($):	$417
Estimated Annual Natural Gas Savings ($):	$97	PBEEEP Provider Cost for Implementation Assistance ($):	$42
		Total Estimated Implementation Cost ($):	$459

Estimated Annual Total Savings ($):	$97	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	4.72	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	4.72	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	1	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.1%	Percent of Implementation Costs:	2.5%

Cx Issues Log

800 Marquette Avenue S
Minneapolis, MN 55402
612-332-8326

Owner	Bureau of Criminal Apprehension
Location	Bemidji, MN
Project	PBEEEP Retro-commissioning
Building	Main

No.	Date Found	System	Issue	Date Resolved	Solution
1	3/2/12 RJR	AHU-1	The building has no perimeter radiation system. Large rooms with exterior exposure are served by a single VAV zone that supplies air that is not warm enough to heat the perimeter and would overheat the interior if it was.		Provide perimeter heating. Radiant ceiling panels using hot water would by one option Not PBEEEP.
2	3/13/12 RJR	Glycol	The control sequence indicates that HWP 5 or 6 and 7 or 8 start when the OA temperature falls below 45º F. Since the system has a moderate amount of return air and heat recovery available, these pumps should only be started when the discharge air temperature falls below the setpoint.		Program glycol heating system to start when the DAT falls below 55º F, field adjustable.
3	3/16/12 RJR	BAS	The OA temperature trend lists some very abrupt changes. Example: at noon on 2l25 the OAT drops 15º for an hour and then rises to the previous reading. On 3/4 the OAT drops 30º in less than 15 minutes.		Not PBEEEP.
4	3/19/12 RJR	AHU-1	DAT drops below 55º F. This could be a bad reading, lack of heating capacity, an actuator problem or something else.		Test controls,

Cx Issues Log

No.	Date Found	System	Issue	Date Resolved	Solution
5	3/19/12 RJR	EF	With rare exception, the VFD controlled exhaust fans operate in a narrow range of 65 to 67%. It would seem that there could be a reduced flow rate when spaces are unoccupied.		
6	3/19/12 RJR	AHU-1	The return air (RA) flow measurement is unrealistically high, compared to the design or supply air (SA) measurement. There would need to be transfer or infiltration flow of 35% of the SA for this to be correct.		Recalibrate the air flow measuring stations (AFMS). The supply AFMS can be calibrated by summing the connected VAV boxes, if they have been calibrated. Not PBEEEP.
7	3/21/12 RJR	AHU-1	Consistent environmental conditions are required for various lab activities. Setback and setup are not acceptable in some areas. A single AHU unit serves the entire building.		Provide a separate unit for the office area. Not PBEEEP.
8	3/21/12 RJR	AHU-1	All air supplied to the lab wing is exhausted.		

Cx Issues Log

No.	Date Found	System	Issue	Date Resolved	Solution
9	3/21/12 RJR	AHU-1	Maintenance staff indicated that the run-around air to air heat recovery system is limited in cold weather by the “high” humidity in the exhaust air stream.	NA	The trend data available to AMEC included one sub-zero night. The heat recovery system operated continuously without apparent incident. If there is a frosting problem during colder weather, AMEC recommends the following. Reduce humidity setpoint to the minimum required for lab operation. Add a defrost cycle so that heat recovery can be used for as many hours of cold weather operation as possible. Not PBEEEP at this time.
10	3/21/12 RJR	AHU-1	Fume hoods are, reportedly, constant volume and include ventilated chemical storage cabinets below the work surface. A more detailed discussion with the manufacturer found that the hood does exhaust less at as the sash is closed. The manufacturer, however, does not rate the flow when the sash is fully closed.	NA	Close the fume hood sashes when the hoods are not in use. Airflow will be reduced, although the manufacturer does not provide a flow rating at that condition. Insufficient data for PBEEEP calculation.
11	3/21/12 RJR	AHU-1	Office areas are maintained at normal occupied temperatures 24/7 when there is little or no occupancy outside of the 50 hours per week of normal business hours.		Provide night setback temperatures of plus or minus 10º F from the normal settings during unoccupied periods. Override switches could be provided.

Cx Issues Log

No.	Date Found	System	Issue	Date Resolved	Solution
12	3/21/12 RJR	EVAV-36	Room 126, Drug Evidence Storage, is supplied with 50 CFM, but the E-VAV(36) is set for 275 CFM and there is no provision for transfer air. The E-VAV typically exhausts 215 CFM.		This should probably be set for about 50 CFM above the exhaust to maintain an attainable flow and reasonable negative pressure. Not PBEEEP.
13	3/21/12 RJR 4/4/12 RJR	VAV-1	This box is not operating correctly, based on the BAS screenshot provided by CEE. The damper is indicated as closed, the flow is indicated as 1036 CFM and the setpoint is 500 CFM. The zone is slightly over cooled. Field measurements indicated no flow from VAV-1. Building staff maintains comfort by opening doors and allowing air to transfer through the area.		Repair and recalibrate the VAV box actuator and/or the flow sensor. Not PBEEEP.
14	3/21/12 RJR 4/4/12 RJR	VAV-4	Temperature setpoint is indicated as 77º F with indicated room temperature at 75. Screen shot indicates a flow setpoint of 310 CFM, flow of 214 and the damper 20% open.		Set for 72º F. Repair and or recalibrate VAV box.
15	3/21/12 RJR	VAV-18	The CEE screenshot indicates airflow of 0 CFM. The scheduled maximum and minimum flow is 1380 CFM.		Repair and recalibrate the VAV box actuator and/or the flow sensor. Not PBEEEP.
16	3/21/12 RJR	VAV-18 Exhaust	The CEE screenshot indicates airflow of 438 CFM while the setpoint is 1400 CFM.		Test and repair or recalibrate the VAV box actuator and/or the flow sensor, as required. Not PBEEEP.

Cx Issues Log

No.	Date Found	System	Issue	Date Resolved	Solution
17	3/21/12 RJR	VAV-28	Temperature setpoint is indicated as 77.5º F with indicated room temperature at 75.5.		Set for 72º F.
18	3/21/12 RJR	VAV-30	The CEE screenshot indicates exhaust airflow of 370 CFM, with a setpoint of 850 and a supply of 580. The room is approximately 200 CFM positive instead of the desired 260 CFM negative.		Test and repair or recalibrate the VAV box actuators and/or the flow sensor, as required. Not PBEEEP.
19	3/21/12 RJR	VAV-63	The CEE screenshot indicates airflow of 560 CFM while the setpoint is 750 CFM.		Test and repair, rebalance or recalibrate the VAV box actuator and/or the flow sensor, as required. Not PBEEEP.
20	3/22/12 RJR	VAV-67	This box does not appear on the plan and was apparently added after the original construction. Where is it?		Not PBEEEP.
21	3/22/12 RJR	VAV-35	The CEE screenshot indicates VAV-35 serves office 168 while the plan indicates that room 164, the Photography Lab is the primary area served. Has there been an additional box installed here?		Not PBEEEP.
22	3/22/12 RJR	VAV-35	The screenshot for VAV-35/room 168 includes an exhaust VAV with no flow and a supply of 1533 CFM. According to the plan, E-VAVs 23, 24, 25 27 & 28 serve this area.		Correct graphic to reflect systems and accurately display flow rates. Not PBEEEP.
23	3/22/12 RJR	VAV-38	The room temperature is indicated as 77.54º F and well above the cooling setpoint.		Verify that the airflow to the space is as indicated and adjust as necessary.

Cx Issues Log

No.	Date Found	System	Issue	Date Resolved	Solution
24	3/26/12 RJR	VAV-2	Trend data shows VAV2 and VAV2 exhaust on the same page. VAV2 should serve an office area and there is no exhaust in that room. Space temperature is consistent and airflow matches the setpoint.		
25	3/27/12 RJR	VAV-5	Trend data indicates that space temperature is maintained air flow follows the setpoint.	NA	
26	3/27/12 RJR	VAV-6	Trend data indicates that space temperature is maintained air flow follows the setpoint.	NA	
26	3/27/12 RJR	VAV-20	Trend data indicates that space temperature is generally maintained. Airflow averages 10% below the setpoint	NA	
27	3/28/12 RJR	VAV-30	Trend data indicates that the space temperature is not maintained during sub-zero weather with full heating output		Check water flow to RH coil. Flow may need to be increased above the design 1.0 GPM Not PBEEEP.
28	3/28/12 RJR	VAV-30	Trend data indicates that the airflow has been increased from 515 to 595 CFM.		Return to design setting if possible.
29	3/28/12 RJR	VAV-31	Trend data indicates that the supply air alternates between a set point of 1710 and 100 CFM. Air flow follows the setpoint well. The design calls for a constant flow of 1550 CFM. Why has this changed?		Not PBEEEP.

Cx Issues Log

No.	Date Found	System	Issue	Date Resolved	Solution
30	3/28/12 RJR	VAV-31	Trend data indicates that the zone temperature is set at 76.9ºF. Space temperature generally stays within 2º, but fell below 70 on a sub-zero night.		Not PBEEEP.
31	3/28/12 RJR	VAV-40	Trend data indicates that air flow follows the setpoint well. .		
32	3/28/12 RJR	VAV-40	Trend data indicates that the space temperature is maintained at or near the setpoint.		
33	3/28/12 RJR	VAV-41	Trend data indicates that air flow follows the setpoint well. .		
34	3/28/12 RJR	VAV-41	Trend data indicates that the space temperature is maintained at or near the setpoint.		
35	3/28/12 RJR	VAV-44	Trend data indicates that air flow follows the setpoint well. .		
36	3/28/12 RJR	VAV-44	Trend data indicates that the space temperature lags below the setpoint during the heating season.		
37	3/28/12 RJR	VAV-45	Trend data indicates that airflow and temperature setpoints are maintained		
38	3/28/12 RJR	VAV-45	Trend data indicates that the space temperature lags below the setpoint during the heating season.		

Cx Issues Log

No.	Date Found	System	Issue	Date Resolved	Solution
38	3/28/12 RJR	VAV-47	Trend data indicates that the space temperature lags slightly below the setpoint during the heating season. Airflow tracks well.		
39	3/27/12 RJR	AHU-1	Office area VAV RH system supplies air 24/7 and maintains normal day shift setpoints.		Allow office area to use night setback and close air supply when space temperature are within specified range (60-80)
40	3/27/12 RJR	HWS	The HWS temperature varies from 172 to -13º F. This sensor is incorrect.		Recalibrate or replace the HWS temperature sensor
41	3/27/12 RJR	HWP-3&4	Pumps have variable frequency drives (VFD), but are limited by discharge valves set half closed. This wastes pumping energy.		Trim pump impellers to the correct size and vary flow with the VFDs. The valve seals are probably eroded to the point where they will not provide full shutoff when the pumps are serviced and may need replacement.
42	3/27/12 RJR	Boilers	Existing boilers are standard efficiency.		Replace boilers with condensing boilers.
43	4/6/12 RJR	Chillers	A screenshot shows inconsistent CHW temperatures. The CHW temp is 47.5 at the evaporator outlet, but 43.4 farther downstream.		Recalibrate sensors. Not PBEEEP
44	4/6/12 RJR	VAV-48 & 49	These VAV boxes provide conditioned air to the boiler room. Air conditioning of boiler rooms is not necessary and a waste of energy.		Provide OA ventilation of the boiler room and disconnect the supply of conditioned air.

Cx Issues Log

No.	Date Found	System	Issue	Date Resolved	Solution
45	4/6/12 RJR	Steam Boilers	Steam boilers were found enabled and hot when the humidifier valve was closed, the heating coil valve closed and the heat recovery system off.		Disable the steam boilers when there is no demand for steam and use the heat reclaim system to provide heat until that capacity is exhausted. Insufficient trend data for PBEEEP analysis.
46	4/6/12 RJR	AHU-1 humidifier	The humidifier valve on the west side of AHU-1 leaks when closed. Steam piping into the AHU was hot and a fog was observed coming from the humidifier. The BAS indicated that the valve was closed.		Repair the valve and disable the humidifier function when the OA temperature exceeds 55º. Insufficient trend data for PBEEEP analysis.
47	4/6/12 RJR	VAV-5	This zone consists of four north facing offices with linear diffusers parallel to the windows. In rooms 112, 113 & 114, the air outlets are substantially covered with tape to stop drafts. It is unknown what is done during warm weather		Verify proper operation of the VAV box, temperature sensors and reheat valve. Not PBEEEP
48	4/6/12 RJR	VAV-31	Plans and the BAS display indicate maximum and minimum airflow of 1710 CFM. The BAS display indicated and actual flow of 41 CFM, a setpoint of 100 and field measurement indicated no airflow.		Verify proper operation and recalibrate the VAV box. Not PBEEEP
49	4/6/12 RJR	VAV-35	The BAS indicates good air supply, but the exhaust is a zero. All exhausts should be operational. This “department” is served by 4 supply VAVs and 6 exhausts. It is unclear which exhaust is indicated.		Verify proper operation of the exhaust VAV boxes and that the correct readings are displayed on the BAS. Not PBEEEP

Cx Issues Log

No.	Date Found	System	Issue	Date Resolved	Solution
50	4/6/12 RJR	E-VAV	Exhaust VAVs are not identified by number on the BAS making monitoring operations difficult.		Add the correct E-VAV identifiers to the BAS display. Not PBEEEP
51	4/6/12 RJR	CO_2	This building uses a high percentage of OA that produces low CO_2 concentrations. Typical readings were in the low 400s.	NA	
52	4/6/12 RJR	EF-1&2	Exhaust fans are set for a -3.2” wc and the BAS indicates a -3.2”. Field measurement with a high quality micromanometer indicated a suction pressure at the fan inlet of -1.7”.		Pressure sensor should be recalibrated. Not PBEEEP

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR
BCA BEMIDJI

Minnesota BCA Bureau of Criminal Apprehension

November 17, 2011

Facility Overview

BCA Bemidji	
Location	3700 N Norris Court, Bemidji, MN 56601
Facility Manager	Jim Dougherty Assistant Laboratory Director
Number of Buildings	1
Interior Square Footage	26,854, square feet (from B3)
PBEEEP Provider	Center for Energy and Environment (Tim Ellingson and Neal Ray, by telephone)
Date Interviewed	11/10/2011
Annual Energy Cost	$119,979 (from 2010 utility data in B3)
Utility Company	Electric: Ottertail Power Natural Gas: Minnesota Energy Resources
Site Energy Use Index (EUI)	433 kBtu/sqft (from 2010 utility data)
Benchmark EUI (from B3)	301 kBtu/sqft

The Bureau of Criminal Apprehension Laboratory is a single building that was constructed in 2001. Located in Bemidji, it includes laboratories, offices, parking garage and service areas.

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The screening of Bureau of Criminal Apprehension Laboratory in Bemidji was carried out by a telephone interview with the assistance of the facility staff. This report is the result of that information.

Recommendation

A limited investigation of the winter season energy usage and energy savings opportunities of the facility is recommended at this time. The table below lists the basic information about the building. The floor area listed in the table has not been verified. The building is approximately 60% laboratory area and 40% offices.

Building Name	State ID	Building	Area (sq ft)	Year Built
BCA Bemidji	G0231025792	Laboratory	26,854	2000

There are many factors that are part of the decision to recommend an energy investigation of a building; at Bureau of Criminal Apprehension Laboratory in Bemidji some of the characteristics that would indicate the building is a good candidate for recommissioning are:

- Level of control by the building automation system
- Equipment size and quantity
- Support from the staff and management to include building in an investigation
- The building has never been commissioned
- Very high energy usage (second highest of all 900 state buildings screened by PBEEEP)

Recommissioning is focused on low-cost and no-cost measures that typically involve control changes and other minor adjustments to equipment operation. The Energy Use Index (EUI) for the campus is 433 kBtu/sqft. This is a 44% above the benchmark for the facility and indicates that there may be opportunities for savings.

Building Descriptions

Details about the campus obtained through the screening process are included in the following:

Mechanical Equipment

There is one AHU for the complex which is approximately 10,000 CFM. The unit has a supply fan and return fan which contain VFDs. There are a total of 5 zones the unit serves. The lab space is 100% OA and 100% exhausted. There are two exhaust fans which exhaust air from the space and also contain VFDs.

There are two natural gas fired hot water boilers which contain two constant volume primary pumps and two constant volume secondary pumps.

There is one chiller which only serves the chilled water coil of the AHU. There are two constant volume chilled water pumps which initiate when demand for cooling is required.

The building has not been commissioned.

The following table lists the key mechanical equipment in the building.

Mechanical Equipment Summary Table	
1	Building Automation System (Schneider Electric IA)
1	Buildings
26,854	Interior Square Feet
1	Air Handler
5	VAV Boxes
2	Exhaust Fans
2	Chillers (1 working)
4	Boilers (2 Hot Water, 2 Steam)
6	Pumps (HW, CHW, etc)

Controls and Trending

The mechanical equipment is controlled by a Schneider Electric-IA which was recently installed (2010) by UHL Company and controls all the mechanical equipment in the building. It is fully capable of trending and has the capacity to trend all the needed points for a PBEEEP energy investigation. Remote access can be granted to the system.

Temperature is controlled by individual thermostats in each room.

The systems operate 365 days a year, heat is always on and cooling is available whenever the outside temperature is above 50 degrees. The control points are set in the EMS and are the same all year.

Lighting

All interior lights are T8 32 watt lights. There are no occupancy sensors for any interior lights and all are controlled by light switches. There are seven lighting zones in the building. Most offices and labs have 2 switches and on average there are 6 to 8 lights per switch.

Exterior lights have a timer and a photocell. The lights operate off the photocell and turn on when it becomes dark outside.

Energy Use Index and B3 Benchmark

The site Energy Use Index (EUI) for the campus is 433 kBtu/sqft. This is 44% higher than the B3 Benchmark of 301 kBtu/sqft. The median site EUI for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks.

Metering

The building has one electric and one natural gas meter.

Documentation

There are plans of the mechanical equipment and control sequences for the equipment on the automation system. When UHL Company installed the new automation system they recommended it be checked if the system needs to be rebalanced.

Building Summary Tables

The following tables are based on information gathered from interviews with facility staff. The purpose of these tables is to provide the size and quantity of equipment and the level of control present in each building. It is complete and accurate to the best of our knowledge.

BCA Laboratory, Bemidji
State ID# G0231025792

Area (sqft)	26,854	Year Built	2000	Occupancy (hrs/yr)	2,080

HVAC Equipment

Air Handlers (1 Total)

Description	Type	Size	Notes
AHU 1	Variable air volume (5 zones)	~10,000 cfm 2 Supply Fans, 40 HP each	VAV with reheats. SF and RF contain VFDs

VAV Boxes (5 Total)

Description	Type	Size	Notes
VAV 1-5	Terminal		Served by AHU 1, Hot water reheat

Exhaust Fans (2 Total)

Description	Type	Size	Notes
		20 HP each	No return air from labs

Fin Tube Radiation

Heating System

Description	Type	Size	Notes
Hot Water Boiler 1	Hot Water Boiler Kewanee	90 HP	Located in Boiler Room, installed in 2000
Hot Water Boiler 2	Hot Water Boiler Kewanee	90 HP	Located in Boiler Room, installed in 2000
Steam Boiler 1	Steam Boiler	20.4 HP	
Steam Boiler 2	Steam Boiler	20.4 HP	

Cooling System

Description	Type	Size	Notes
Chiller 1	Trane		Installed in 2000
Chiller 2	Trane		Installed in 2000, Compressors not currently in working order

On Site Generator

Description	Type	Size	Notes
			Original in 2000

Points on BAS

Air Handlers

Description	**Points**
AHU 1	

Rooftop Units

Description	**Points**
RTU 1	

Heating System

Description	**Points**
Boiler 1	
Boiler 2	

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	hp	Horsepower
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temperature	HWRT	Hot Water Return Temperature
cfm	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CV	Constant Volume	MAT	Mixed Air Temperature
DA	Discharge Air	MAU	Make-up Air Unit
DA Enth	Discharge Air Enthalpy	OA	Outside Air
DARH	Discharge Air Relative Humidity	OA Enth	Outside Air Enthalpy
DAT	Discharge Air Temperature	OARH	Outside Air Relative Humidity
DDC	Direct Digital Control	OAT	Outside Air Temperature
DP	Differential Pressure	Occ	Occupied
DSP	Duct Static Pressure	PTAC	Packaged Terminal Air Conditioner
DX	Direct Expansion	RA	Return Air
EA	Exhaust Air	RA Enth	Return Air Enthalpy
EAT	Exhaust Air Temperature	RARH	Return Air Relative Humidity
Econ	Economizer	RAT	Return Air Temperature
EF	Exhaust Fan	RF	Return Fan
Enth	Enthalpy	RH	Relative Humidity
ERU	Energy Recovery Unit	RTU	Rooftop Unit
FCU	Fan Coil Unit	SF	Supply Fan
FPVAV	Fan Powered VAV	Unocc	Unoccupied
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes

Conversions
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH